

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appln. Of: JOHN MADOCKS
Serial No.: 10/036,067
Filed: October 19, 2001
For: PLASMA TREATMENT APPARATUS
Group: 1763
Examiner: Rudy Zervigon DOCKET: 10630/9

Board of Patent Appeals and Interferences
US Patent and Trademark Office
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Dear Sir:

Appellant's Brief On Appeal

This Brief is being filed in support of Appellant's Appeal from the Primary Examiner to the Board of Patent Appeals and Interferences, the Notice of which was timely filed on January 6, 2004. Appellant is filing a Petition For A Three Month Extension on even date herewith. In the event there are any fee deficiencies or additional fees are payable, please charge them (or credit any overpayment) to our Deposit Account No. 502262.

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REAL PARTIES IN INTEREST

The real party in interest in this appeal is Applied Process Technologies, Inc., an Arizona corporation. On or about October 18, 2001, Applicant / Appellant John Madocks assigned all right, title, and interest, in and to the Application having Serial No. 10/036,067 to Applied Process Technologies, Inc.

RELATED APPEALS AND INTERFERENCES

To the best of the knowledge of the undersigned attorney and the Appellant, no other appeals or interferences exist which will affect or be directly affected, or have a bearing on, the instant appeal.

STATUS OF CLAIMS ON APPEAL

Claims 1 through 33 stand rejected and are on Appeal. The claims on appeal are set forth in **Appendix A**.

STATUS OF THE AMENDMENTS

A Final Office Action was mailed on July 16, 2003. Appellant timely filed a Notice of Appeal on August 21, 2002.

SUMMARY OF THE INVENTION ON APPEAL

The invention on appeal comprises a plasma treatment apparatus which includes a magnet shunt 4, a pair of magnets 9 and 10, and magnetic poles 2 and 3. FIG. 1; Page 6, Lines 7-8. These elements generate a magnetic field 11 in the gap 23 between poles 2 and 3. FIG. 1; Page 6, Lines 8-9. The apparatus further includes an electrical circuit which includes an anode comprising magnet shunt 4, and two cathodes comprising pole pieces 2 and 3. FIG. 1; Page 6, Lines 10-12. Substrate 1 is disposed adjacent pole pieces 5 and 6, and within magnetic field

11. FIG. 1; Page 6, Lines 6-7.

ISSUES PRESENTED ON APPEAL

The issues presented on appeal are:

1. Whether claims 1-33 are unpatentable under 35 U.S.C. § 103(a) over Flemming (U.S. Pat. No. 3,955,118).

GROUPING OF CLAIMS

1. Claims 1, 2, 4, 5, 6, 7, and 15, stand or fall as a group.
2. Claim 3 stands or falls separately.
3. Claims 8, 9, and 10, stand or fall as a group.
4. Claims 11 and 12 stand or fall as a group.
5. Claims 13 and 14 stand or fall as a group.
6. Claims 16 and 17 stand or fall as a group.
7. Claims 18, 19, and 20, stand or fall as a group.
8. Claims 21, 22, 23, 24, 25, 26, and 31, stand or fall as a group.
9. Claim 27 stands or falls separately.
10. Claim 28 stands or falls separately.
11. Claim 29 stands or falls separately.
12. Claim 30 stands or falls separately.
13. Claim 32 stands or falls separately.
14. Claim 33 stands or falls separately.

ARGUMENTS ON APPEAL

I. THE EXAMINER IMPROPERLY REJECTS CLAIMS 1 - 15 UNDER 35 USC § 103(a) AS BEING UNPATENTABLE OVER FLEMMING

A. *Flemming Fails To Teach Or Suggest All The Elements Of Appellant's Claim 1*

Appellant's claim 1 is directed to a plasma treatment apparatus which includes, *inter alia*, a set of magnets. Flemming nowhere teaches or suggests an apparatus comprising a set of magnets. Rather, Flemming teaches an apparatus comprising a single electromagnet, i.e. coil 14.

The Examiner clearly misreads Flemming in this regard. In the Office Action dated February 4, 2003, the Examiner incorrectly asserts, *inter alia*, that Flemming teaches "a set of electromagnets (14; Figure 1; column 2, lines 50-65; column 3, lines 25-26). See, February 4, 2003 Office Action at page 3. In a subsequent Office Action dated July 16, 2003, the Examiner again incorrectly asserts, *inter alia*, that Flemming teaches "a set of electromagnets . . ." See, July 16, 2003 Office Action at page 2. Flemming's FIG. 1 is a cross-sectional view, and therefore, the two portions of coil 14 shown in FIG. 1, i.e. one portion to the left of anode 11 and one portion to the right of anode 11, comprise a single annular coil.

Flemming clearly teaches an apparatus which includes a single electromagnet 14. "Source 10 is cylindrical in outline, thus anode 11, coil 14, magnetic collar 15, and anode insulator 16 are essentially tube-shaped." Col. 2, Lines 54-56. Thus, Flemming expressly describes coil 14 as "essentially tube-shaped." Flemming nowhere teaches or suggests an apparatus which comprises a set of magnets as recited in Appellant's claim 1.

Appellant's claim 1 further recites, *inter alia*, "at least first and second cathodes

separated by a gap, said first cathode comprising a first exposed cathode surface and a first magnetic polarity, said second cathode comprising a second exposed cathode surface and a second magnetic polarity, and said first exposed cathode surface oriented non-parallel to said second exposed cathode surface.” Appellant respectfully submits that Flemming nowhere teaches or suggests an apparatus which comprises a first cathode and a second cathode separated by a gap.

Appellant further respectfully submits that the Examiner again misreads Flemming. In the February 4, 2003 Office Action, the Examiner opines that Flemming teaches “at least first (left side item 13; Figure 1; column 2, lines 50-65) and second (right side item 13; Figure 1; column 2, lines 50-65) cathodes separated by a gap 22.” *See*, February 4, 2003 Office Action at page 3. The Examiner misinterprets the two portions of cathode 13 shown in cross-section, i.e. the “left side item 13” and the “right side item 13,” as comprising two, different cathodes. The Examiner repeats this erroneous reading of Flemming in the July 16, 2003 Office Action.

Flemming unequivocally teaches that cathode 13 comprises a single structure. As noted above, Flemming’s apparatus is cylindrical. Flemming expressly teaches that cathode 13 is “essentially disk-shaped.” Col. 2, Line 57. Thus, Flemming’s cathode 13 comprises a single, disk-shaped structure which includes an aperture at the center. Flemming nowhere teaches or suggests an apparatus which includes a first cathode and a second cathode separated by a gap, as recited in Appellant’s claim 1.

Appellant’s claim 1 further recites a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap. Flemming nowhere teaches or suggests an apparatus comprising a magnetic field which exits a first cathode, crosses a gap

between that first cathode and a second cathode, and enters the second cathode. Quite to the contrary, Flemming teaches an apparatus which includes an axial magnetic field disposed within the bore of a hollow anode 11. Col. 2 at Lines 62-63.

It is well-settled that “[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” MPEP 2143.03; *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Flemming nowhere teaches or suggests an apparatus which comprises a set of magnets, as recited in Appellant’s claim 1. Moreover, Flemming nowhere teaches or suggests an apparatus which comprises a first cathode and a second cathode separated by a gap. In addition, Flemming nowhere teaches or suggests an apparatus which comprises a magnetic field which exits a first cathode, crosses a gap between that first cathode and a second cathode, and enters the second cathode.

Therefore, Appellant respectfully submits that the Examiner incorrectly rejects Appellant’s claim 1 under 35 U.S.C. § 103(a) as being unpatentable over Flemming.

B. Flemming Fails To Teach Or Suggest All The Elements Of Appellant’s Claims 2-15

Claims 2 through 15, inclusive, depend, directly or indirectly, from claim 1. Under 35 U.S.C. § 112, fourth paragraph, “a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.” Therefore, claims 2 through 15, inclusive include all the elements of claim 1. “If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious.” MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

For the reasons set forth above, Appellant respectfully submits that Flemming does not render obvious Applicant’s claim 1. This being the case, Appellant further respectfully submits

that claims 2 through 15, as amended herein, are non-obvious over Flemming.

The separate patentability of claim 3 is worthy of note. Claim 3 recites, *inter alia*, a plasma treatment apparatus which includes a mirror-type magnetic field. The written description defines a mirror magnetic field as one that confines electrons in a weak central magnetic field by stronger magnetic fields at the ends. *See*, Application at page 16, lines 3 through 24. Flemming nowhere teaches or suggests an apparatus which includes such a mirror magnetic field.

The separate patentability of claims 8, 9, 10, 11, and 12, are worthy of note. Claim 8 recites a plasma treatment apparatus which includes a first exposed cathode surface having a width W1 measured transverse to its length in combination with a facing cathode having a width W2 measured transverse to its length, where W1/W2 is no less than 0.2.

The Examiner acknowledges that "Flemming does not teach the relative dimensions of the cathode surfaces." *See*, February 4, 2003 Office Action at page 5. The Examiner unsuccessfully attempts to cure the deficiencies of Flemming by relying on case law which holds that the dimensions of a disposable plastic container were not significant.

Appellant respectfully asserts that the relative dimensions of his cathodes are significant. Significantly, Flemming expressly controverts the Examiner's thesis, and supports Appellant's. Flemming expressly teaches that "[t]he shape of the cathodes contributes to the configuration of the field in chamber 20, and thus to the shape of the plasma discharge." Col. 3, Lines 32-34. Therefore, Flemming unequivocally teaches that the shape of the cathodes is significant. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 8 as unpatentable over Flemming.

Claim 9 recites a plasma treatment apparatus wherein the length of the first exposed cathode surface is greater than the width W2. For the reasons set forth above, the dimensions and shape of the cathodes are significant. *See*, Flemming at Col. 3, Lines 32-34. "Flemming does not, however, teach or suggest the relative dimensions of the cathode surfaces." *See*, February 4, 2003 Office Action at page 5. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 9 as unpatentable over Flemming.

Claim 10 recites a plasma treatment apparatus wherein the width W1 is no less than 1 cm. For the reasons set forth above, the dimensions and shape of the cathodes is significant. *See*, Flemming at Col. 3, Lines 32-34. "Flemming does not, however, teach or suggest the relative dimensions of the cathode surfaces." *See*, February 4, 2003 Office Action at page 5. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 10 as unpatentable over Flemming.

Claim 11 recites a plasma treatment apparatus wherein the cathodes comprise ends and a central portion, and wherein the cathodes are shaped such that the gap is wider at the ends than at the central portion. The Examiner acknowledges that "Flemming does not teach cathodes that are shaped such that the gap is wider at the end than at the central portion." *See*, February 4, 2003 Office Action at page 5. As noted above, Flemming does, however, teach that "the shape of the cathodes contributes to the configuration of the field in the chamber, and thus the shape of the plasma discharge." Col. 3, Lines 32-34. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 11 as unpatentable over Flemming.

The separate patentability of claims 13 and 14 are worthy of note. Claim 13 recites a

plasma treatment apparatus which comprises a magnetic field comprising a maximum strength field line, where the portion of the maximum strength field line disposed adjacent one of the cathodes has a magnetic field strength B1, and where the portion of that maximum strength field line disposed in a central portion of the gap comprises a minimum magnetic field strength B2, such that B1/B2 is greater than 2. Claim 14 recites a plasma treatment apparatus wherein the B1/B2 is greater than 4.

The Examiner acknowledges that “Flemming does not teach . . . strengths of magnetic field lines.” *See*, February 4, 2003 Office Action at page 5. Appellant respectfully submits that Fleming neither teaches nor suggests an apparatus which comprises a magnetic field comprising a maximum strength field line, where the portion of the maximum strength field line disposed adjacent one of the cathodes has a magnetic field strength B1, and where the portion of that maximum strength field line disposed in a central portion of the gap comprises a minimum magnetic field strength B2, such that B1/B2 is greater than 2, or such that B1/B2 is greater than 4. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claims 13 and 14 as unpatentable over Fleming.

II. THE EXAMINER IMPROPERLY REJECTS CLAIMS 16-17 UNDER 35 USC § 103(a) AS BEING UNPATENTABLE OVER FLEMMING

A. Fleming, Fails To Teach Or Suggest All The Elements Of Appellant's Claim 16

Appellant's claim 16 is directed to a plasma treatment apparatus which includes, *inter alia*, “a set of magnets.” Fleming nowhere teaches or suggests an apparatus comprising a set of magnets. Rather as set forth in greater detail above, Fleming teaches an apparatus comprising a single electromagnet, i.e. coil 14.

Appellant's claim 16 recites a plasma treatment apparatus further comprising, *inter alia*, "at least first and second cathodes separated by a gap, said first cathode comprising a first exposed cathode surface and a first magnetic polarity, said second cathode comprising a second exposed cathode surface and a second magnetic polarity." Appellant respectfully submits that Flemming nowhere teaches or suggests an apparatus which comprises a first cathode and a second cathode separated by a gap. As set forth in greater detail above, Flemming nowhere teaches or suggests an apparatus which includes a first cathode and a second cathode separated by a gap.

Appellant's claim 16 recites a plasma treatment apparatus which further comprises a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap. Flemming nowhere teaches or suggests an apparatus comprising a magnetic field which exits a first cathode, crosses a gap between that first cathode and a second cathode, and enters the second cathode. Quite to the contrary, Flemming teaches an apparatus which includes an axial magnetic field disposed within the bore of a hollow anode 11. Col. 2 at Lines 62-63.

It is well-settled that "[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art." MPEP 2143.03; *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Flemming nowhere teaches or suggests an apparatus which comprises a set of magnets, as recited in Appellant's claim 16. Moreover, Flemming nowhere teaches or suggests an apparatus which comprises a first cathode and a second cathode separated by a gap, as recited in Appellant's claim 16. In addition, Flemming nowhere teaches or suggests an apparatus which comprises a magnetic field which exits a first

cathode, crosses a gap between that first cathode and a second cathode, and enters the second cathode, as recited in Appellant's claim 16.

Therefore, Appellant respectfully submits that the Examiner incorrectly rejects Appellant's claim 16 under 35 U.S.C. § 103(a) as being unpatentable over Flemming

B. Flemming Fails To Teach Or Suggest All The Elements Of Appellant's Claim 17

Claim 17 depends from claim 16. Under 35 U.S.C. § 112, fourth paragraph, "a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers." Therefore, claim 17 includes all the elements of claim 16. "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

For the reasons set forth above, Appellant respectfully submits that Flemming does not render obvious Applicant's claim 16. This being the case, Appellant further respectfully submits that claim 17 is non-obvious over Flemming.

III. THE EXAMINER IMPROPERLY REJECTS CLAIMS 18-20 UNDER 35 USC § 103(a) AS BEING UNPATENTABLE OVER FLEMMING

A. Flemming. Fails To Teach Or Suggest All The Elements Of Appellant's Claim 18

Appellant's claim 18 is directed to a plasma treatment apparatus which includes, *inter alia*, "a set of magnets." Flemming nowhere teaches or suggests an apparatus comprising a set of magnets. Rather, Flemming teaches an apparatus comprising a single electromagnet, i.e. coil 14.

Flemming clearly teaches an apparatus which includes a single electromagnet 14.

"Source 10 is cylindrical in outline, thus anode 11, coil 14, magnetic collar 15, and anode

insulator 16 are essentially tube-shaped.” Col. 2, Lines 54-56. Thus, Flemming expressly describes coil 14 as “essentially tube-shaped.” Flemming nowhere teaches or suggests an apparatus which comprises a set of magnets as recited in Appellant’s claim 1.

Appellant’s claim 18 further recites, *inter alia*, “at least first and second cathodes separated by a gap, said first cathode comprising a first exposed cathode surface and a first magnetic polarity, said second cathode comprising a second exposed cathode surface and a second magnetic polarity, and said first exposed cathode surface oriented non-parallel to said second exposed cathode surface.” For the reasons set forth above, Appellant respectfully submits that Flemming nowhere teaches or suggests an apparatus which comprises a first cathode and a second cathode separated by a gap.

It is well-settled that “[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” MPEP 2143.03; *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Flemming nowhere teaches or suggests an apparatus which comprises a set of magnets, as recited in Appellant’s claim 18. Moreover, Flemming nowhere teaches or suggests an apparatus which comprises a first cathode and a second cathode separated by a gap, as recited in Appellant’s claim 18. Therefore, Appellant respectfully submits that the Examiner incorrectly rejects Appellant’s claim 1 under 35 U.S.C. § 103(a) as being unpatentable over Flemming

B. Flemming Fails To Teach Or Suggest All The Elements Of Appellant’s Claims 19-20

Claims 19 and 20 depend from claim 18. Under 35 U.S.C. § 112, fourth paragraph, “a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.” Therefore, claims 19 and 20 include all the elements of claim 1. “If

an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious.” MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

For the reasons set forth above, Appellant respectfully submits that Flemming does not render obvious Applicant’s claim 18. This being the case, Appellant further respectfully submits that claims 19 and 20 are non-obvious over Flemming.

IV. THE EXAMINER IMPROPERLY REJECTS CLAIMS 21-26 UNDER 35 USC § 103(a) AS BEING UNPATENTABLE OVER FLEMMING

A. *Flemming. Fails To Teach Or Suggest All The Elements Of Appellant’s Claim 21*

Appellant’s claim 21 is directed to a plasma treatment apparatus which includes, *inter alia*, “a set of magnets.” Flemming nowhere teaches or suggests an apparatus comprising a set of magnets. Rather as set forth above, Flemming teaches an apparatus comprising a single electromagnet, i.e. coil 14.

Appellant’s claim 21 further recites, *inter alia*, “at least first and second cathodes separated by a gap, said first cathode comprising a first exposed cathode surface and a first magnetic polarity, said second cathode comprising a second exposed cathode surface and a second magnetic polarity.” Appellant respectfully submits that Flemming nowhere teaches or suggests an apparatus which comprises a first cathode and a second cathode separated by a gap, much less an apparatus which comprises a first cathode having a first magnetic polarity and a second cathode having a second magnetic polarity, where those cathodes are separated by a gap.

Appellant’s claim 21 further recites a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap. Flemming nowhere teaches or suggests an apparatus comprising a magnetic field which exits a first cathode, crosses a gap

between that first cathode and a second cathode, and enters the second cathode. Quite to the contrary, Flemming teaches an apparatus which includes an axial magnetic field disposed within the bore of a hollow anode 11. Col. 2 at Lines 62-63.

It is well-settled that “[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art.” MPEP 2143.03; *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Flemming nowhere teaches or suggests an apparatus which comprises a set of magnets, as recited in Appellant’s claim 21. Moreover, Flemming nowhere teaches or suggests an apparatus which comprises a first cathode and a second cathode separated by a gap, as recited in Appellant’s claim 21. In addition, Flemming nowhere teaches or suggests an apparatus which comprises a magnetic field which exits a first cathode, crosses a gap between that first cathode and a second cathode, and enters the second cathode, as recited in Appellant’s claim 21.

Therefore, Appellant respectfully submits that the Examiner incorrectly rejects Appellant’s claim 21 under 35 U.S.C. § 103(a) as being unpatentable over Flemming.

B. Flemming Fails To Teach Or Suggest All The Elements Of Appellant’s Claims 22-25

Claims 22 through 25, inclusive, depend from claim 21. Under 35 U.S.C. § 112, fourth paragraph, “a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers.” Therefore, claims 22 through 25, inclusive, include all the elements of claim 21. “If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious.” MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

For the reasons set forth above, Appellant respectfully submits that Flemming does not

render obvious Applicant's claim 21. This being the case, Appellant further respectfully submits that claims 22 through 25 are non-obvious over Flemming.

V. THE EXAMINER IMPROPERLY REJECTS CLAIMS 27-33 UNDER 35 USC § 103(a) AS BEING UNPATENTABLE OVER FLEMMING

Claims 27 through 33, inclusive, depend from two or more of claims 1, 16, 18, or 21.

Under 35 U.S.C. § 112, fourth paragraph, "a claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers." "If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." MPEP 2143.03; *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988).

For the reasons set forth above, Applicant respectfully submits that Flemming does not render obvious any of claims 1, 16, 18, or 21. This being the case, Applicant further respectfully submits that claims 27 through 33, inclusive, are non-obvious over Flemming.

The separate patentability of claim 27 is worthy of note. Claim 27 is directed to a plasma treatment apparatus wherein the cathodes comprise removeable shells. Flemming nowhere teaches or suggests use of cathodes comprising removeable shells. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 27 as unpatentable over Flemming.

The separate patentability of claim 28 is worthy of note. Claim 28 is directed to a plasma treatment apparatus wherein the magnetic field is asymmetrical with respect to a central axis of the gap extending between the cathodes. The Examiner acknowledges that "Flemming does not teach that an asymmetrical magnetic field is generated with respect to a central axis of the gap extending between the cathodes by altering the arrangement of the cathodes as supported by Applicant's specification." See, February 4, 2003 Office Action at page 5.

Appellant further respectfully submits that Flemming neither teaches nor suggests a plasma treatment apparatus wherein the magnetic field is asymmetrical with respect to a central axis of the gap extending between the cathodes. This being the case, Appellant further respectfully submits that the Examiner incorrectly rejects claim 28 as unpatentable over Flemming.

The separate patentability of claim 29 is worthy of note. Claim 29 is directed to a plasma treatment apparatus wherein the cathodes are asymmetrical with respect to a central axis of the gap. Flemming nowhere teaches or suggests a plasma treatment apparatus wherein are asymmetrical with respect to a central axis of the gap. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 29 as unpatentable over Flemming.

The separate patentability of claim 30 is worthy of note. Claim 30 is directed to a plasma treatment apparatus comprising a set of magnets, wherein those magnets comprise permanent magnets. The Examiner acknowledges that "Flemming does not teach permanent magnets in place of his electromagnets."¹ See, February 4, 2003 Office Action at page 5. Appellant respectfully submits that Flemming nowhere teaches or suggests a plasma treatment apparatus comprising a set of permanent magnets. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 30 as unpatentable over Flemming.

The separate patentability of claim 32 is worthy of note. Claim 32 is directed to a plasma treatment apparatus wherein each of the cathodes comprises a plurality of segments positioned adjacent to one another along the length axis. The Examiner acknowledges that "Flemming does not teach that each of the cathodes comprises a plurality of segments

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¹ As noted above, the Examiner incorrectly posits that Flemming teaches an apparatus comprising more than a single magnet.

positioned adjacent to one another along the length axis." See, February 4, 2003 Office Action at page 6. Appellant respectfully submits that Flemming neither teaches nor suggests a plasma treatment apparatus wherein each of the cathodes comprises a plurality of segments positioned adjacent to one another along the length axis. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 32 as unpatentable over Flemming.

The separate patentability of claim 33 is worthy of note. Claim 33 is directed to a plasma treatment apparatus wherein a substrate is positioned on both sides of the gap for treatment by the plasma. Flemming nowhere teaches or suggests the orientation of his device with respect to a substrate. This being the case, Appellant respectfully submits that the Examiner incorrectly rejects claim 33 as unpatentable over Flemming.

CONCLUSION

In view of the foregoing, Appellant respectfully requests that the Examiner's rejection of the subject application be reversed in all respects.

Respectfully submitted,



Dale F. Regelman
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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Board of Patent Appeals and Interferences, US Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450, on June 4, 2004, at Tucson, Arizona.

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APPENDIX A

1. A plasma treatment apparatus, comprising:

at least first and second cathodes separated by a gap, said first cathode comprising a first exposed cathode surface and a first magnetic polarity, said second cathode comprising a second exposed cathode surface and a second magnetic polarity, and said first exposed cathode surface oriented non-parallel to said second exposed cathode surface;

a set of magnets operative to generate a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap;

said magnetic field comprising a first magnetic field portion crossing the gap and passing through said first exposed cathode surface, said first magnetic field portion comprising magnetic field lines having a maximum field strength of at least 100 Gauss;

at least one anode structure positioned to create an electric field extending from the cathodes to the anode structure, at least a portion of said electric field crossing said magnetic field and forming a closed-loop electron containment region within said magnetic field, a sufficient voltage between the anode structure and the cathodes operative to form a plasma within the magnetic field when a gas is present near the containment region at a gas pressure between 0.1 and 100 mTorr; and

at least one substrate positioned to be treated by said plasma.

2. The apparatus of claim 1 wherein the substrate is positioned to be treated by the plasma with a treatment selected from the group consisting of: a chemical vapor deposition process, a surface modification process, an etching process, a sputter-coating process, and combinations thereof.

3. The apparatus of claim 1 wherein the magnetic field comprises a mirror-type magnetic field at least in a peripheral portion of the magnetic field.
4. The apparatus of claim 1 wherein the first exposed cathode surface faces the substrate.
5. The apparatus of claim 4 wherein the first exposed cathode surface extends over a length measured along the gap and a width measured transverse to the length, and wherein the width is at least 1 cm.
6. The apparatus of claim 1 wherein at least one of the cathodes comprises a non-planar cathode surface.
7. The apparatus of claim 6 wherein at least one of the cathodes comprises a facing cathode surface having a shape selected from the group consisting of: a point, a bevel, a rounded surface, a stepped surface, a ridged surface, and combinations thereof.
8. The apparatus of claim 1 wherein the first cathode comprises a facing cathode surface oriented to face the second cathode, wherein the first exposed cathode surface has a length extending along the gap and width W1 measured transverse to the length, wherein the facing cathode surface has a width W2 measured transverse to the length, and wherein $W1/W2$ is no less than 0.2.
9. The apparatus of claim 8 wherein the length is greater than the width W2.
10. The apparatus of claim 8 wherein the width W1 is no less than 1 cm.
11. The apparatus of claim 1 wherein the cathodes comprise ends and a central portion, and wherein the cathodes are shaped such that the gap is wider at the ends than at the central portion.
12. The apparatus of claim 11 wherein the ends of the cathodes are beveled.

13. The apparatus of claim 1 wherein the magnetic field comprises a maximum strength magnetic field line, wherein the maximum strength magnetic field line has a maximum magnetic field strength B_1 adjacent one of the cathodes and a minimum magnetic field strength B_2 at a central portion of the gap, and wherein B_1/B_2 is greater than 2.

14. The apparatus of claim 13 wherein B_1/B_2 is greater than 4.

15. The apparatus of claim 1 wherein the electron containment region is centered in a plane that is oriented perpendicular ($\pm 45^\circ$) to a portion of the substrate adjacent to the gap.

16. A plasma treatment apparatus, comprising:

at least first and second cathodes separated by a gap, said first cathode comprising a first magnetic polarity, and said second cathode comprising a second magnetic polarity;

a set of magnets operative to generate a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap;

at least one anode structure positioned to create an electric field extending from the cathodes to the anode structure, at least a portion of said electric field crossing said magnetic field and forming a closed-loop electron containment region within said magnetic field, a sufficient voltage between the anode structure and the cathodes operative to form a plasma within the magnetic field when a gas is present near the containment region at a gas pressure between 0.1 and 100 mTorr; and at least one substrate positioned to be treated by said plasma;

wherein the magnetic field is asymmetrical with respect to a central axis of the gap extending between the cathodes, and wherein the electron containment region

extends farther away from the central axis on one side of the gap than on the other side of the gap.

17. The apparatus of claim 16 wherein the substrate is positioned on said one side of the gap.

18. A plasma treatment apparatus, comprising:

at least first and second cathodes separated by a gap, said first cathode comprising a first magnetic polarity, and said second cathode comprising a second magnetic polarity;

a set of magnets operative to generate a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap;

at least one anode structure positioned to create an electric field extending from the cathodes to the anode structure, at least a portion of said electric field crossing said magnetic field and forming a closed-loop electron containment region within said magnetic field, a sufficient voltage between the anode structure and the cathodes operative to form a plasma within the magnetic field when a gas is present near the containment region at a gas pressure between 0.1 and 100 mTorr;

at least one substrate positioned to be treated by said plasma; and

a set of ferromagnetic elements magnetically coupled to the set of magnets to provide a ferromagnetic return magnetic path, thereby enhancing the magnetic field across the gap.

19. The apparatus of claim 18 wherein the electron containment region comprises first and second portions situated on respective sides of the gap, and wherein the second portion is situated between the gap and at least one element selected from the group consisting of: the set of magnets and the set of ferromagnetic elements.

20. The apparatus of claim 18 wherein the set of magnets and the set of ferromagnetic elements are included in a magnetic circuit, and wherein the gap is the largest non-ferromagnetic opening in the magnetic circuit.

21. A plasma treatment apparatus, comprising:

at least first and second cathodes separated by a gap, said first cathode comprising a first magnetic polarity, and said second cathode comprising a second magnetic polarity;

a set of magnets operative to generate a magnetic field exiting from one of the cathodes and entering the other of the cathodes, thereby crossing the gap;

at least one anode structure positioned to create an electric field extending from the cathodes to the anode structure, at least a portion of said electric field crossing said magnetic field and forming a closed-loop electron containment region within said magnetic field, a sufficient voltage between the anode structure and the cathodes operative to form a plasma within the magnetic field when a gas is present near the containment region at a gas pressure between 0.1 and 100 mTorr;

at least one substrate positioned to be treated by said plasma; an enclosure extending from the cathodes around a portion of the electron containment region positioned away from the substrate; and

a source of process gas positioned within the enclosure.

22. The apparatus of claim 21 wherein a major portion of the process gas from the source passes through the plasma containment region in leaving the enclosure.

23. The apparatus of claim 21 wherein the source of process gas comprises a tube positioned within the enclosure, said tube comprising gas-release openings.

24. The apparatus of claim 21 wherein the source of process gas comprises an evaporation source.

25. The apparatus of claim 21 wherein the source of process gas comprises a sputter source.

26. The apparatus of claim 21 wherein the source is positioned between the enclosure and a portion of the electron containment region.

27. The apparatus of claims 1, 16, 18 or 21 wherein the cathodes comprise removable shells.

28. The apparatus of claims 1, 18 or 21 wherein the magnetic field is asymmetrical with respect to a central axis of the gap extending between the cathodes, and wherein the electron containment region extends farther from the central axis on a front side of the gap facing the substrate than on a back side of the gap facing away from the substrate.

29. The apparatus of claims 1, 16, 18 or 21 wherein the cathodes are asymmetrical with respect to a central axis of the gap.

30. The apparatus of claims 1, 16, 18 or 21 wherein the set of magnets comprises a permanent magnet.

31. The apparatus of claims 1, 16, 18 or 21 wherein the set of magnets comprises an electromagnet.

32. The apparatus of claims 1, 16, 18 or 21 wherein the gap is elongated along a length axis, and wherein each of the cathodes comprises a plurality of segments positioned adjacent to one another along the length axis.

33. The apparatus of claims 1 or 18 wherein the at least one substrate is positioned on both sides of the gap for treatment by the plasma.